New method for diagnosing malaria

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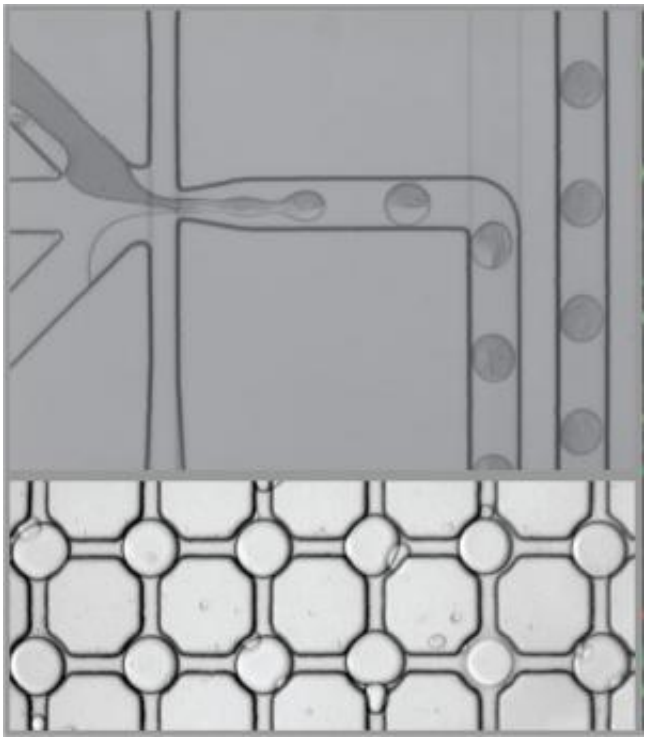


The high sensitivity is achieved by performing the REEAD technology within droplets surrounded by oil. The malaria parasites are distributed in the pico-litre droplet, where they react effectively with the other components of the REEAD technology Credit: Sissel Juul and Birgitta Knudsen

Danish researchers have developed a new and sensitive method that makes it possible to diagnose malaria from a single drop of blood or saliva. The method might eventually be used in low-resource areas without the need for specially trained personnel, expensive equipment, clean water or electricity. With the development of this method, the

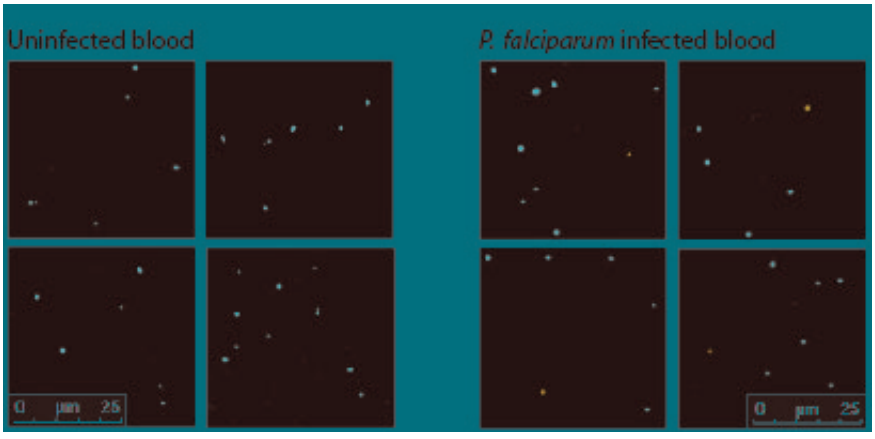
researchers hope to go one step further in identifying and treating all patients suffering from malaria.

Malaria is a life-threatening disease that strikes more than 200 million people every year – mainly in Africa, Asia and Latin America. The disease is caused by the *Plasmodium* parasite, which is spread by infected mosquito bites. Today, malaria can be prevented and successfully treated, but more than half a million people nevertheless die every year from the disease.

Large-scale monitoring and treatment programmes during the past decade have reduced the distribution of the disease, and the frequency of actual epidemics has fallen. However, the number of malaria patients with relatively low infection counts has increased, and the need for more sensitive methods to diagnose the disease has thus increased dramatically.

Development of new, simple and sensitive method

To meet this need, researchers at Aarhus University have developed a new method that can diagnose malaria infections with very high sensitivity. The method is based on measuring the activity of an enzyme called topoisomerase I from the *Plasmodium* parasite.



The new method amplifies the signal from the malaria parasites since each parasite can give rise to more DNA molecules using the REEAD technology. Under the microscope, each DNA product is seen as a red dot. Credit: Sissel Juul and Birgitta Knudsen

The researchers have developed a technology called REEAD (Rolling Circle-Enhanced Enzyme Activity Detection) – which makes it possible to diagnose malaria from a single drop of blood or saliva. This method is much more time-effective and cost-effective than current diagnostic methods, and can be performed by personnel who have no specialised training. It can therefore be used in low-resource areas without the use of expensive equipment, clean water or electricity.

The ongoing fight against malaria is complicated by increasing problems with resistant *Plasmodium* parasites. In addition, several *Plasmodium* species (*P. vivax* and *P. knowlesi*) cannot be detected with the usual quick-test methods.

The new REEAD-based method distinguishes itself from other quick-test methods because it can measure whether a given *Plasmodium* infection is resistant to drugs. The newly developed technology is also the only quick-test method that makes it possible to diagnose the less common malaria parasites (*P. ovale*, *P. knowlesi* and *P. malariae*) in addition to the most common *Plasmodium* parasites (*P. falciparum* and *P. vivax*).

The unique sensitivity, combined with its ability to detect infection in very small samples of blood or saliva, makes the method suitable for large-scale screening projects. This is of great importance in areas where

the disease is close to being eradicated, and where it is therefore essential to identify and treat all patients infected with one of the above-mentioned parasites – even those who do not show symptoms of the disease.

Interdisciplinary, international collaboration

"This combination of molecular biologists, doctors, engineers and statisticians has been important for our success in developing the new method," says Associate Professor Birgitta Knudsen, who is the driving force behind the project.

More information: Droplet Microfluidics Platform for Highly Sensitive and Quantitative Detection of Malaria-Causing Plasmodium Parasites Based on Enzyme Activity Measurement: pubs.acs.org/doi/abs/10.1021/nn3038594

Provided by Aarhus University

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